ZBA Inc.

ZIGBEE Module

with on-board antenna

PN: ZZB88-441S

User Manual

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1 Document Status

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2 Introduction

This highly integrated wireless communication module, embeds all of the necessary components to perform a virtual plug and play function for ZIGBBE RF transceivers. The module contains many of the necessary features required to built a reliable RF communication network such as;, anti-interference ability, support for multiple network topologies including self healing features, point to point, or point to multipoint configuration which can be composed as star, tree, mesh tree network structure and of course low power modes. .

The module is divided into a center coordinator, routers and end nodes, these three distinct modes of operation provide the user with the option for different network Structures that can be optimized for the particular application. The center of the network is the coordinator node which is responsible for launching the network's organization, network maintenance and management, The data router function built-into the device, which is responsible for transferring the data within the Zigbee network to the coordinator and eventually to the host. The terminal nodes are typically at the end of the network and typically perform the sensing and data acquisition function.

The coordinator, routers and end nodes configured by software commands. .

3 Features

- Surface mount module with ceramic on-board antenna
- Miniature module solution
- 8KB of data memory
- Operating Frequency Band 2.40 GHz~2.48GHz unlicensed ISM Band
- IEEE 802.15.4 & ZigBee compliant
- Based upon the TI family of Zigbee SOC
- Multiple network topologies include MESH, Star, and point to point
- Large Network capacity
- Self-healing network. topology
- Low power consumption
- Sleep current (with active sleep timer) 2.8μA at 2.7V to 3.6V
- Easily configurable into different modes
- Broadcast, MASTER/SLAVE and point to point mode
- Royalty–free software
- Eliminate the need for complex RF Design and evaluation
- Easy to use AT command set for configuration control
- Class 2 type Output Power
- Precision Crystal oscillator on-board
- Industrial temperature range (-20 to +70°C)

4 Product performance

4.1.1 Low power consumption

This module can be configured in a variety of energy-saving modes, in which it is possible to have a fully operational system run for more than 6 months on two AA batteries.

4.1.2 Network self-organization, self-healing ability

The Network configuration features of this module will allow the self-organizing of the network without human intervention. The network's nodes can sense the presence of other nodes and determine the connection between composition and structure of the network;

The self-healing function can change the order in which data traverses through the network to compensate for a change in node position, or node failures, etc. Low cost

This Zigbee module operates in the unlicensed ISM band at 2.40 GHz~2.48GHz and comes with royalty-free firmware thereby yielding an extremely low cost system solution.

4.1.3 Network capacity

The specification for Zigbee network does allow for up to a maximum of 65,534 nodes in the particular network. The Zigbee module can be configured to communicate via a standard serial

data (RS232 data) via the UART interface, and the firmware will allow you to transmit broadcast messages to the other devices in the network. Any module in the network can be queried from the coordinator to determine it operational mode and its relative position within the network.

5 Technical Specifications

5.1 Absolute Max Ratings

Parameter	Min	Max	Units	Condition
Supply voltage	–0.3	3.9	V	All supply pins must have the same voltage
Voltage on any digital pin	–0.3	VDD+0.3, max 3.9	V	
Voltage on the 1.8V pins (pin no. 22, 25-40 and 42)	–0.3	2.0	V	
Input RF level		10	dBm	
Storage temperature	–50	150	°C	Device not programmed
ESD		<500 V	**V**	On RF pads (RF_P, RF_N, AVDD_RF1, and AVDD_RF2), according to Human Body Model, JEDEC STD 22, method A114
		700 V	**V**	All other pads, according to Human Body Model, JEDEC STD 22, method A114
		200 V	**V**	According to Charged Device Model, JEDEC STD 22, method C101

5.2 Electrical Description

5.2.1 Recommended operating voltage

Name	Min	Type	Max	Units
Vcc-In	2.0	3.0	3.6	V
Vcr-Filter	1.75	1.8	1.85	V

The actual electrical characteristics (rated operating current) Vcc = Vcc-In

Name	Min	Type	Max	Unit
Logic“0”Input Voltage	0	0.7	0.9	V
Logic“1”Input Voltage	Vcc-0.7	Vcc	Vcc	V
Logic“0”Output Voltage (note1)	0	0	0.25	V
Logic“1”Output Voltage (note1)	Vcc-0.25	Vcc	Vcc	V
Logic“0”Input Current (note2)	NA	-1	-1	uA
Logic“1”Input Current (note3)	NA	1	1	uA
I/O pin pull-up and pull-down resistor I	17	20	23	KΩ

note1: For 4mA output current on all pins except P1_0 and P1_1 which are rated to 20mA;

note2: Input equals 0V ;

note3: Input equals Vcc ;

5.3 Electrical Specifications

5.3.1 Current Consumption

Measured with Ta=25°C and VDD=3.0V unless stated otherwise.

Operational mode	Current	Unit	Measurement condition
MCU Active and RX Mode	26.7	mA	MCU running at full speed (32MHz), 32MHz XOSC running, radio in RX mode, -50 dBm input power. No peripherals active. Code run with Cache hit.
MCU Active and TX Mode, 0dBm	26.9	mA	MCU running at full speed (32MHz), 32MHz XOSC running, radio in TX mode, 0dBm output power. No peripherals active. Code run with Cache hit.
MCU Active Mode, 32 MHz	9.5	mA	MCU running at full speed (32MHz), 32MHz XOSC running. No radio or peripherals active. Code run with Cache hit.
Power mode 1	190	µA	Digital regulator on, High frequency RCOSC and crystal oscillator off. 32.768 kHz XOSC, POR and ST active. RAM retention.
Power mode 2	0.5 0	µA	Digital regulator off, High frequency RCOSC and crystal oscillator off. 32.768 kHz XOSC, POR and ST active. RAM retention.
Power mode 3	0.3	µA	No clocks. RAM retention. POR active.

5.4 General Characteristics

5.4.1 Wake-Up and Timing

Measured with Ta = 25 ° C and VDD = 3.0V unless stated otherwise.

Parameter	Min	Typ	Max	Unit	Condition/Note
Power mode 1 → mode 0		4.1		µS	Digital regulator on, High frequency RCOSC and crystal oscillator off. Startup of High frequency RCOSC.
Power mode 2 or 3 → mode 0		89.2		µS	Digital regulator off, High frequency RCOSC and crystal oscillator off. Startup of regulator and High frequency RCOSC.
Active → TX or RX Active → TX or RX 32MHz XOSC initially OFF. Voltage regulator initially OFF		525		µS	Time from enabling radio part in power mode 0, until TX or RX starts. Includes start-up of voltage regulator and crystal oscillator in parallel. Crystal ESR=16Ω.
Active → TX or RX Voltage regulator initially OFF		320		µS	Time from enabling radio part in power mode 0, until TX or RX starts. Includes start-up of voltage regulator.
Active → RX or TX			192	µS	Radio part already enabled... Time until RX or TX starts.

5.5 RF Receive Section

5.5.1 RF Receive Parameters

Measured with TA = 25 ° C and VDD = 3.0V unless stated otherwise.

Parameter	Min	Typ	Max	Unit	Condition/Note
Receiver sensitivity		-91		dBm	PER (packet error rate) = 1%, as specified by [1] Measured in 50 Ω single ended through a balun. [1] requires –85 dBm
Saturation (maximum input level)		10		dBm	PER = 1%, as specified by [1] Measured in 50Ω Single ended through a balun. [1] requires -20 dBm
Adjacent channel rejection + 5 MHz channel spacing		41		dB	Wanted signal -88dBm, adjacent modulated channel at +5 MHz, PER = 1 %, as specified by [1]. [1] requires 0 dB
Adjacent channel rejection - 5 MHz channel spacing		30		dB	Wanted signal -88dBm, adjacent modulated channel at -5 MHz, PER = 1 %, as specified by [1]. [1] requires 0 dB
Alternate channel rejection + 10 MHz channel spacing		55		dB	Wanted signal -88dBm, adjacent modulated channel at +10 MHz, PER = 1 %, as specified by [1] [1] requires 30 dB
Alternate channel rejection - 10 MHz channel spacing		53		dB	Wanted signal -88dBm, adjacent modulated channel at -10 MHz, PER = 1 %, as specified by [1] [1] requires 30 dB
Channel rejection ≥ + 15 MHz ≤ - 15 MHz		 55 53		 dB dB	Wanted signal @ -82 dBm. Undesired signal is an 802.15.4 modulated channel, stepped through all channels from 2405 to 2480 MHz. Signal level for PER = 1%. Values are estimated.
Co-channel rejection		-6		dB	Wanted signal @ -82 dBm. Undesired signal is 802.15.4 modulated at the same frequency as the desired signal. Signal level for PER = 1%.
Blocking / Desensitization + 5 MHz from band edge		 -42		 dBm	Wanted signal 3 dB above the sensitivity level, CW jammer, PER = 1%. Measured according to EN 300 440 class 2.
+ 10 MHz from band edge		-45		dBm	
+ 20 MHz from band edge		-26		dBm	
+ 50 MHz from band edge		-22		dBm	
- 5 MHz from band edge		-31		dBm	
- 10 MHz from band edge		-36		dBm	
- 20 MHz from band edge		-24		dBm	

- 50 MHz from band edge		-25		dBm	
Spurious emission					Conducted measurement in a 50 Ω single ended load. Complies with EN 300 328, EN 300 440 class 2, FCC CFR47, Part 15 and ARIB STD-T-66
30 – 1000 MHz		-64		dBm	
1 – 12.75 GHz		-75		dBm	
Frequency error tolerance		±140		ppm	Difference between centre frequency of the received RF signal and local oscillator frequency. [1] requires minimum 80 ppm
Symbol rate error tolerance		±900		ppm	Difference between incoming symbol rate and the internally generated symbol rate [1] requires minimum 80 ppm

5.5.2 RF Transmit Section

Measured with TA = 25 ° C and VDD = 3.0V unless stated otherwise.

Parameter	Min	Typ	Max	Unit	Condition/Note
Nominal output power		0		dBm	Delivered to a single ended 50Ω load through a balun and output power control set to 0x5F (TXCTRLL). [1] requires minimum –3 dBm
Programmable output power range		25.8		dB	The output power is programmable in 16 steps from approximately –25.2 to 0.6 dBm...
Harmonics					. Measurement conducted with 100 kHz resolution bandwidth on spectrum analyzer and output power control set to 0x5F (TXCTRLL). Output Delivered to a single ended 50Ω load through a balun.
2nd harmonic		-50.7		dBm	
3rd harmonic		-55.8		dBm	
4th harmonic		-54.2		dBm	
5th harmonic		-53.4		dBm	
Spurious emission					Maximum output power. The peak conducted spurious emission is -47dBm@192MHz which is in an EN300440 restricted band limited to -54dBm.
30 - 1000 MHz		-47		dBm	
1– 12.75 GHz		-43		dBm	
1.8 – 1.9 GHz		-58		dBm	
5.15 – 5.3 GHz		-56		dBm	
Error Vector Magnitude (EVM)		11		%	Measured as defined by [1] [1] Requires max. 35 %
Optimum load impedance		115 + j180		Ω	Differential impedance as seen from the RF-port (RF_P and RF_N) towards the antenna...

5.6 Analog to Digital Converter

Measured with TA = 25 ° C, VDD = 3.0V.Preliminary characterized parameters.

Parameter	Min	Typ	Max	Unit	Condition/Note
Input voltage	0		AVDD	V	AVDD is voltage on AVDD_SOC pin
External reference voltage	0		AVDD	V	AVDD is voltage on AVDD_SOC pin
External reference voltage differential	0		AVDD	V	AVDD is voltage on AVDD_SOC pin
Input resistance, ADC single-ended input		167		kΩ	AIN0 to AIN7 selected as ADC input
Input resistance, ADC differential input2		TBD			
Input resistance, single-ended reference		49		kΩ	AIN7 selected as external reference input
Input resistance, differential reference1		TBD			
Effective number of bits (ENOB)2		5.5 7.3 9.0 10.5		Bits	8-bits setting. 10-bits setting. 12-bits setting. 14-bits setting.
Effective number of bits (ENOB) Differential input1 E		TBD			
Offset1		TBD		LSB	
Conversion time		20 36 68 132		µS µS µS µS	8-bits setting. 8-bits setting. 10-bits setting. 10-bits setting. 12-bits setting. 12-bits setting. 14-bits setting. 14-bits setting.
Differential nonlinearity (DNL)3		± 0.14	1.0	LSB	8-bits setting. 8-bits setting.
Integral nonlinearity (INL) 2		±0.5	3.4	LSB	8-bits setting. 8-bits setting.
SINAD2 (Sine input signal frequency 1 Hz and 1 kHz)		34 46 56 65		dB dB dB dB	8-bits setting. 10-bits setting. 12-bits setting. 14-bits setting.

ADC Characteristics

1. Only for devices with Chip Version register, CHVER.VERSION equal to 0x02 or greater
2. Not characterized for this data sheet revision.
3. Single-ended input signal and AVDD used as reference. Sine input, tested at frequencies 1 Hz and 1 kHz

6 Hardware Interface Specification

6.1 Module Pin-out

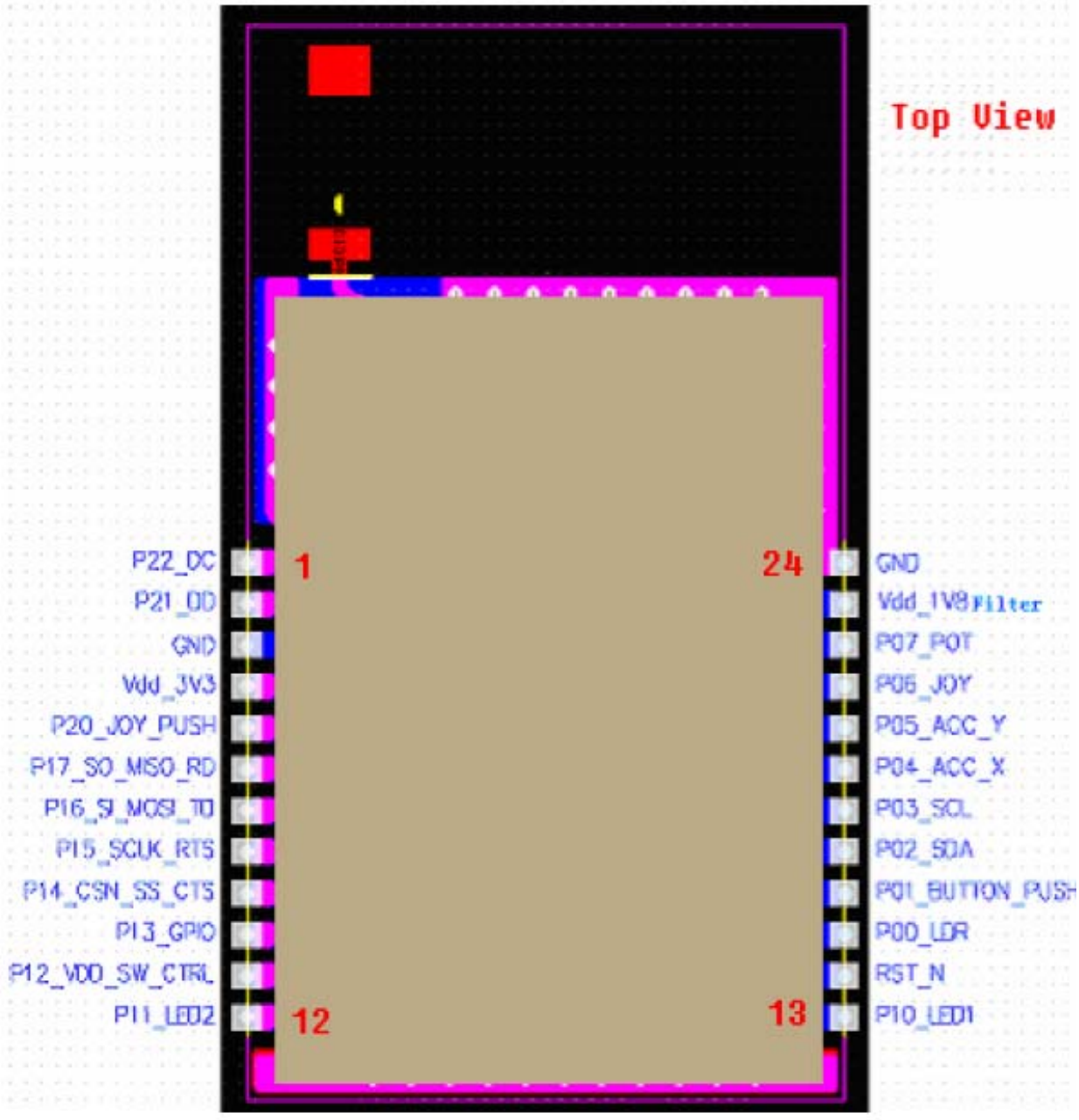

Figure 6-1 Pin out of the module

6.2 Recommended PCB layout

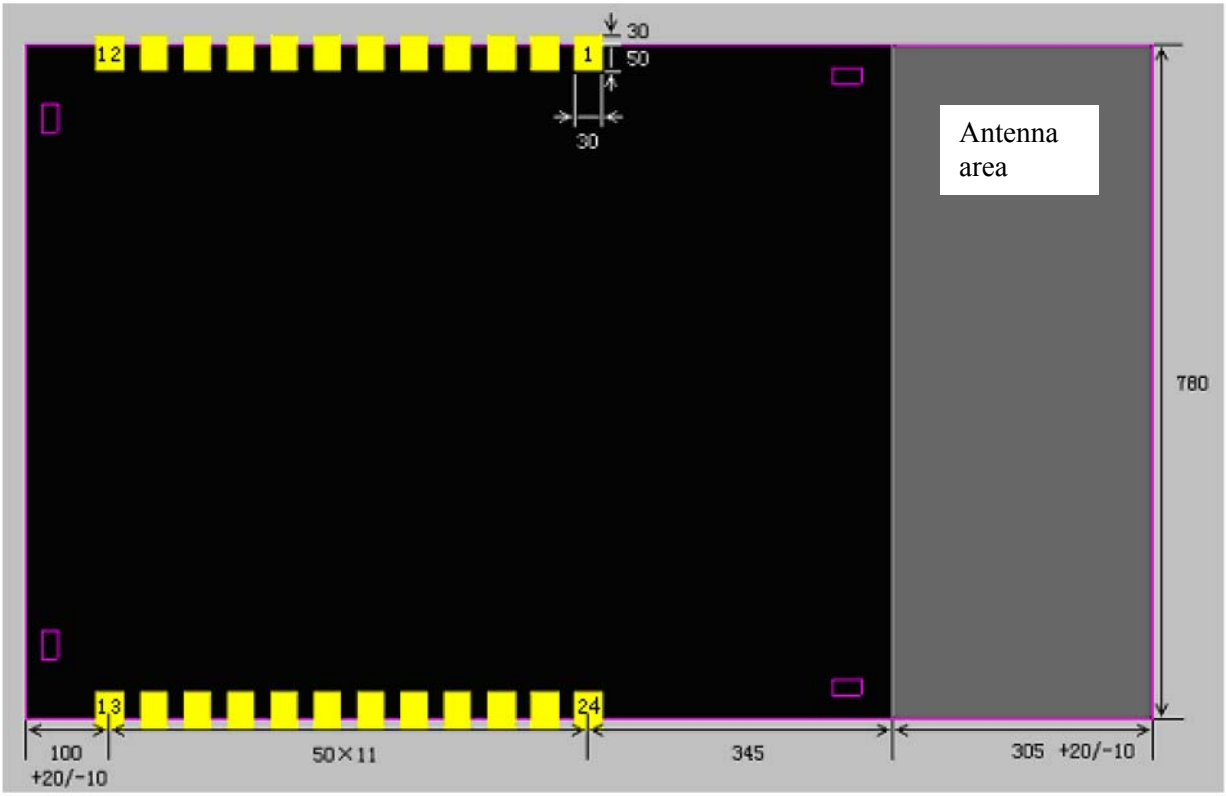

Figure 6-2 Recommended PCB layc Dimensions in mm

Pin List

Pin No.	Function	Type	Description
1	P22	Digital I/O	
2	P21	Digital I/O	
3	GND	Ground	System ground.
4	Vcc-In	Power Input	2.0V-3.6V digital power supply for digital I/O.
5	P20	Digital I/O	
6	P17	Digital I/O	
7	P16	Digital I/O	
8	P15	Digital I/O	
9	P14	Digital I/O	
10	P13	Digital I/O	
11	P12	Digital I/O	
12	P11	Digital I/O	Network LED (20mA drive capability)

13	P10	Digital I/O	Indicator LED Drive (20mA capability)
14	RST		Reset, active low.
15	P00	Digital I/O	
16	P01	Digital I/O	Input for Mode switching functions hi=configuration mode, low-running mode
17	P02	Digital I/O	
18	P03	Digital I/O	
19	P04	Digital I/O	
20	P05	Digital I/O	
21	P06	Digital I/O	
22	P07	Digital I/O	
23	Vcr-Filter	Power Output	1.8V Voltage regulator power supply output. Only intended for supplying the analog 1.8V part.
24	GND	Ground	System ground.

7 Functional Interface Specification

7.1 Mode switch port

Input/ output port PIO_01 is configured as a mode switching port. When the module is controlled by an external microprocessor switching this pin will allow the user to switch between the normal operation running mode and the command mode. When the mode pin is set to a logic low level "0" the module is in the active, operational mode. When the mode pin is set to logic high state "1" then the module is in configuration parameters. See table below for a summary.

Mode pin State	Operational state
Logic low	Zigbee network operational MODE
Logic high	Command mode

Figure 7-1 Table of Mode switch port function

7.2 Indicator

This Zigbee wireless module has allocated two PIO to operate as status LED indicators. The instructions were operational mode (pin 13 →P10), and the network indication (pin 12 →P11), the two (2) LEDs indicate status and are described in the following table:

Indicator	LED status	Description	
Operating instructions (port =P10)	LED indicator will flash once each second	The system operating normally	
	LED indicator is illuminated constantly	The module is in the configuration set-up mode.	
	LED indicator is Off	System is not running, indicating a power or system failure	
Network instructions (port = P11)	LED indicator is Off	Central node (coordinator)	A successful network has been created
		Routing node	The node has Join the network
		Terminal node	The node has Join the network
	Always	Not connected to the network	

Figure 7-2 Table of Indicator LED function

7.3 Data Interface

The Zigbee module can be operated via communication to a standard UART function with either a four (4) wire + ground UART connection (TX, RX, RTS, CTS, GND) or a two (2) wire +ground UART connections (TX, RX, GND)

The default data interface parameters:

Serial port parameters	Default
Baud Rate	9600
Parity	NONE
Data bits	8
Stop bit	1

Figure 7-3 Table of default communication parameters

7.4 Configuration Interface

When the ZIGBEE wireless communication module MODE switch pin (PIO_01) pin is connected high, the system enters the command mode; low on this pin will shift the module's operating mode to the operational mode. .

The command mode will only accept command at a fixed communication setting as outlined in the table below.

Serial Port parameters	Fixed comm. parameters
Baud Rate	9600
Parity	NONE
Data bits	8
Stop bit	1

Figure 7-4 Table of command communication parameters

8 The UART

The module provides four-wire+ Ground serial asynchronous communication interface;
The following diagram shows the TXD, RXD, CTS, RTS signals for the UART and the direction of the data flow. The voltage levels of the UART are low= 0 Volts and Hi = Vdd (3.3Volts). For two (2) wire + Ground operation do not connect CTS and RTS.

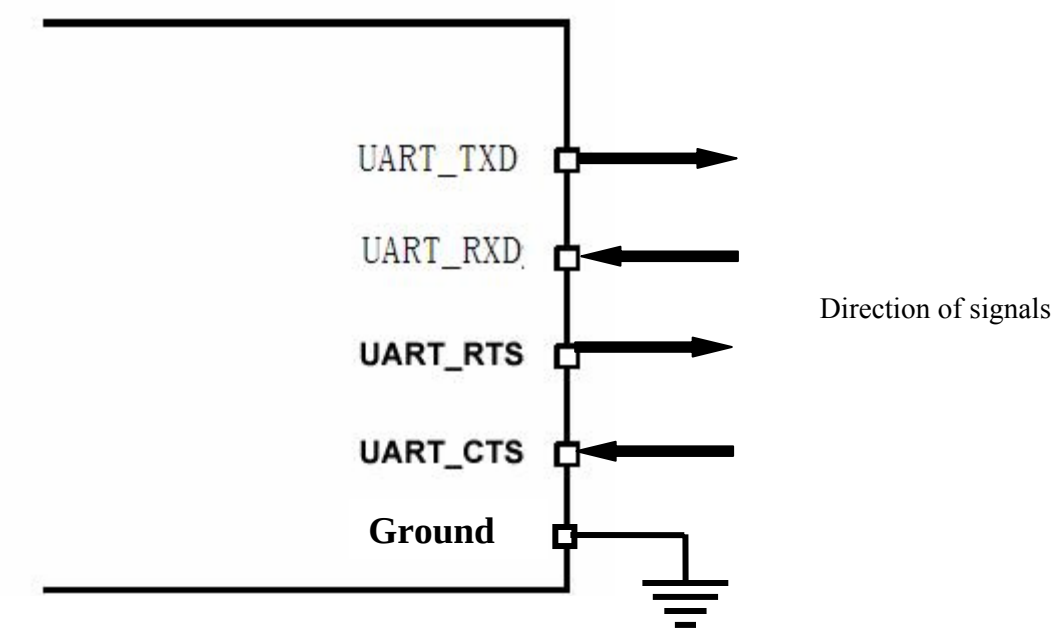

Figure 8-1 Diagram of the UART four (4) wire +ground interface:

9 Module Configuration Commands

9.1 Instruction 1: Test command

Command	Response	Parameters
AT\r\n	OK	No

9.2 Instruction 2: check the version number

Command	Response	Parameters
AT+VERSION? \r\n	OK \ r \ n + VERSION: <Para1> \ r \ n	Para1: the version number

9.3 Instruction 3: Set / Query the baud rate

Command	Response	Parameters
AT+BAUD=<Para1>\r\n	OK	Para1: baud rate (1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400) Default： 9600
AT+BAUD?\r\n	OK \r\n + BAUD : <Para1>\r\n	

Note: The communication parameters used during the communication mode is fixed at 9600 N 8 1

9.4 Instruction 4: Set / Query flowcontrol mode

Command	Response	Parameters
AT+ FLOWCONTROL=<Para1>\r\n	OK	<Para1> : <Para1>: 0: No flow control 1: The hardware flow control Default: 1
AT+ FLOWCONTROL?\r\n	OK \r\n + FLOWCONTROL: <Para1>\r\n \	

9.5 Instruction 5: Set / query the serial data bit

Command	Response	Parameters
AT+ DATABIT=<Para1>\r\n	OK	<Para1> : <Para1>: 8: 8 9: 9 Default: 8
AT+ DATABIT?\r\n	OK \r\n + DATABIT : <Para1>\r\n \	

9.6 Instruction 6: set / check the serial port stop bits

Command	Response	Parameters
AT+ STOPBIT=<Para1>\r\n	OK	<Para1> : 1: 1 Stop bit 2: 2 Stop bits Default: 1 stop bit
AT+ STOPBIT?\r\n	OK \r\n + STOPBIT: <Para1>\r\n	

9.7 Instruction 7: set / query port parity

Command	Response	Parameters
AT+ VERIFYBIT=<Para1>\r\n	OK	<Para1> : 0: no parity 1: odd parity 2: even parity Default: 0
AT+ VERIFYBIT?\r\n	OK \r\n + VERIFYBIT : <Para1>\r\n	

9.8 Instruction 8: Set / Query the device type

Command	Response	Parameters
AT+ ROLE=<Para1>\r\n	OK	<Para1>: 0: The central node 1: The routing node 2: The terminal node Default: 1
AT+ ROLE?\r\n	OK \r\n + ROLE : <Para1>\r\n	

9.9 Instruction 9: Set / query the network ID

Command	Response	Parameters
AT+ PANID=<Para1>\r\n	OK	<Para1> : 0000 ~ 3FFF Default:
AT+ PANID\r\n	OK \r\n + PANID : <Para1>\r\n \	

9.10 Command 10: Set / query the communication channel

Command	Response	Parameters
AT+ CHANNEL=<Para1>\r\n	OK	<Para1> : 0 ~ 15 Default:
AT+ CHANNEL\r\n	OK \r\n + CHANNEL : <Para1>\r\n	

Communication channel	Channel / Frequency	Remarks
0~15	00/ 2.405GHz	It is recommended to use channels 4, 9, 14, 15 to avoid interference with any local WIFI.

	01/ 2.410 GHz 02/ 2.415 GHz 03/ 2.420 GHz 04/ 2.425GHz 05/ 2.430 GHz 06/ 2.435GHz 07/ 2.440 GHz 08/ 2.445GHz 09/ 2.450 GHz 10/ 2.455GHz 11/ 2.460 GHz 12/ 2.465GHz 13/ 2.470 GHz 14/ 2.475GHz 15/ 2.480 GHz	

9.11 Command 11: Set / query the data transmission mode

Command	Response	Parameters
AT+ SENDTYPE =<Para1>\r\n	OK	<Para1> : 0: Broadcast Mode 1: Master-slave mode 2: Point-to-point mode
AT+ SENDTYPE \r\n	OK \r\n + SENDTYPE : <Para1>\r\n	

0) **Broadcast Mode**: When operating the broadcast mode; each of the nodes in the network will be able to receive the broadcast message.
1) **Master-slave mode**: When operating in the Master Slave mode the serial data is sent to the central coordinator. The other nodes in the network simply act as a pass through and do not actually receive the serial data. The Serial Data terminates at the Central coordinator.
2) **Point to point Mode:** When operating in point to point mode: the node must format the data as outlined below, such that the serial transmit and receive data are properly interpreted. (See below for the specific point to point data format)

9.12 Command12: Restore default settings

Command	Response	Parameters
AT+RESET\r\n	OK	No

9.13 Command 13: Query MAC address of the local module

Command	Response	Parameters
AT+LEXTADDR?\r	\r\nOK\r\n \r\n+LEXTADDR:<eaddr>\r\n	eaddr: 64-bit extended MAC address

10 Point-to-point mode Data specification

When the module is operating in point-to-point mode the data format is based on following format. If the module are not configured to receive the serial data in to following format then data will be considered invalid. The AT+_SENDTYPE =2 is the appropriate command.

10.1 Overview of the data packet format (point -to-point)

Packet format is defined as the 5 byte header plus valid data, as follows:

Sync		Package Type	Sequence Number	Data length	Valid data
0x55	0xAA	1 Byte	1 Byte	1 Byte	(0 - 80) Bytes

1) **Sync:** each packet by 0x55, 0xAA start a data packet used to synchronize
2) **Package Type:** 1 byte length type field, used to indicate the type of the current packet, the case of AT commands or other types of packets.

Specific packet types are as follows:

Package Type	Help	Data transmission direction
0x 00	Additional AT Command Request	External MCU → Zigbee Module
0x01	Additional AT Command Response	Zigbee Module → External MCU
0x10	Packet	Two-way
0x20	Package receiving response	Zigbee Module→ External MCU

3) **Sequence Number**: This parameter is one byte in length and it represents the sequence of commands form a particular module. The Serial number sequence is first set by the Zigbee module during the 0x20 package receiving response. Each subsequent communication the serial number will be incremented by one (1)

4) **Data length**: 1 byte of data length field, which contains the number of bytes of data. Maximum data length is **80** bytes.

5) Valid data: This field is data, and the length of the data is indicated by the previous byte. .

10.2 Additional AT command request (0x00) & Response (0x01) Packet

In point to point mode, the following example is used to show how to inquire the local MAC address. This method can also be used to, a) MAC address lookup of remote devices through a short address queries through the network Remote MAC address, b) short address by the network of parent-child query node, c) query the local node and the neighbor node signals, etc..

The following is an example of the format of the data (hex) flow between the

a) External processor to the Zigbee nodule: (check local MAC address)

55 AA 00 01 0D 41 54 2B 4C 45 58 54 41 44 44 52 3F 0D

Header	Package Type	Seq. #	Data len.	Valid data
55 AA	00	01	0D	41 54 2B 4C 45 58 54 41 44 44 52 3F 0D

b) Zigbee modules response to the external processor: (packet reception response)

55 AA 20 01 06 0D 0A 4F 4B 0D 0A

Header	Package Type	Seq. #	Data len.	Valid data
55 AA	20	01	0D	0D 0A 4F 4B 0D 0A

c) The local MAC address Zigbee module [MAC address=+LETXADDR:0000000000001211]

55 AA 01 01 1E 0D 0A 2B 4C 45 58 54 41 44 44 52 3A 30 30 30 30 30 30 30 30 30 30 30 30 31 32 31 31 0D 0A

Header	Package Type	Seq. #	Data len.	Valid data
55 AA	01	01	1E	0D 0A 2B 4C 45 58 54 41 44 44 52 3A 30 30 30 30 30 30 30 30 30 30 30 30 31 32 31 31 0D 0A

10.3 Instruction 1: MAC address of the local inquiry

Command	Response	Parameters
AT+LEXTADDR?\r	\r\n+LEXTADDR:<eaddr>\r\n	eaddr: 64-bit extended MAC address

Note: In the configuration state, it is also a "check the local MAC address" command; but in the configuration state to send the command without adding header, you can directly only in work mode, and when the point to point mode, only need to increase the header.

10.4 Instruction 2: Query a short address local network

Command	Response	Parameters
AT+LSHORTADDR?\r	\r\n+LSHORTADDR:<saddr>\r\n	saddr: 16-bit short address

10.5 Instruction 3: MAC address of the remote query

Command	Response	Parameters
AT+REXTADDR= <saddr>\r <saddr> \ r	\r\n+REXTADDR: <saddr>,<eaddr>\r\n	saddr: 16-bit short address eaddr: 64-bit extended MAC address

10.6 Instruction 4: Query remote short address

Command	Response	Parameters
AT+RSHORTADDR= <eaddr> \ r	\r\n+RSHORTADDR: <eaddr>,<saddr>\r\n	eaddr: 64-bit extended MAC address saddr: 16-bit short address

10.7 Instruction 5: parent and child nodes query node

Command	Response	Parameters
AT+ASSOCDEVLIST= <saddr>\r	\r\n+ASSOCDEVLIST: <paddr>,<caddr>\r\n … ... \r\nOVER\r\n	paddr: parent node short address caddr: child node short address

10.8 Instruction 6: check the signal with the parent and child nodes

Command	Response	Parameters
AT+ASSOCDEVRSSI?\r	\r\n+ASSOCDEVRSSI: <saddr>,<rssi>\r\n … ... \r\nOVER\r\n \	saddr: Remote short address rssi : rssi:

10.9 Instruction 7: check the signal with the surrounding nodes

Command	Response	Parameters
AT+NEIGHBORRSSI?\r	\r\n+NEIGHBORRSSI: <saddr>, <rssi> \ r \ n \r\nOVER\r\n	saddr: Remote short address rssi : rssi:

10.10 Data Packet (0x10)

The following is the format of the data:

0x55	0xAA	0x10	Length of the data length (1 byte)	Network Short Address (2 bytes)	Payload (length minus 2 bytes of Network short address)

1) **Header:** This consists of the following hex values: 0x55 0xAA 0x10

2) **Length of Data**: the length of this data is one byte; this length includes the network short address and the payload data.

3) **Network Short Address:** this address is 2 bytes in length. When the node joins the network the parent will assign a short address to indicate the location of the particular node.

4) **Payload:** the data content to be sent, its length is the length of the header field value minus 2 bytes associated with the network short address byte

Such as:

MAC address of the remote device is retrieved by using Instruction #4 above.

To send the string "HelloWorld" for the 0001 short address to the network equipment:

The zigbee module will send the following data

55 AA 10 0C 00 01 48 65 6C 6C 6F 57 6F 72 6C 64.

Special Note:

When the transmission of data starts, the load flow of data packets can be very large, it is recommended to enable the module's flow control model, which ensures reliable high-speed data transmission.

- If hardware flow-control is set to enable then the external microprocessor must strictly follow flow control configuration for the entire packet (0x01) including the effective length up to 80 bytes (including handle). And the transmission response message (0x20) must be confirmed.
- If you choose not to use flow control then the transmit packet and the reply packet (0x20) for a way to be should have less than a 100ms delay, otherwise it is possible that there will be a loss of data.

10.11 Packet response (0x20)

Packet response is for data packets and error packets.

0x55	0xAA	0x20	Data length	Status

Status	The results described below
\r\nOK\r\n	Correct answers
\r\nERROR\r\n	Package type error: not a valid packet types defined.

11 Mounting Recommendations

11.1 Recommended Module Locations for On-Board Antenna

For maximized performance please orient the device with the antenna as close to the outside of the housing as possible. Best performance will occur if the underlying PCB does not have a ground plane under the area where the antenna is located. A ground plane directly underneath the antenna region will drastically reduce the range of the module. The absolute minimum nearest ground plane should be 3mm away from any point on the antenna; 5 mm or greater is preferred.

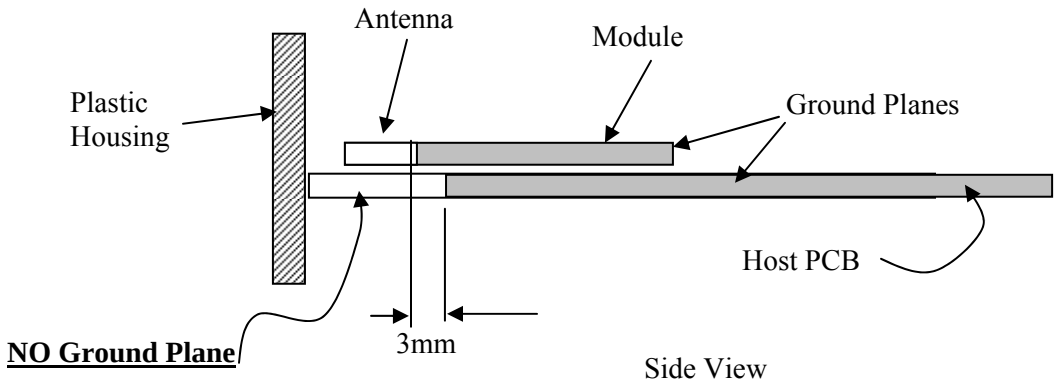

Figure 11-1 Side view of Zigbee module mounting recommendations

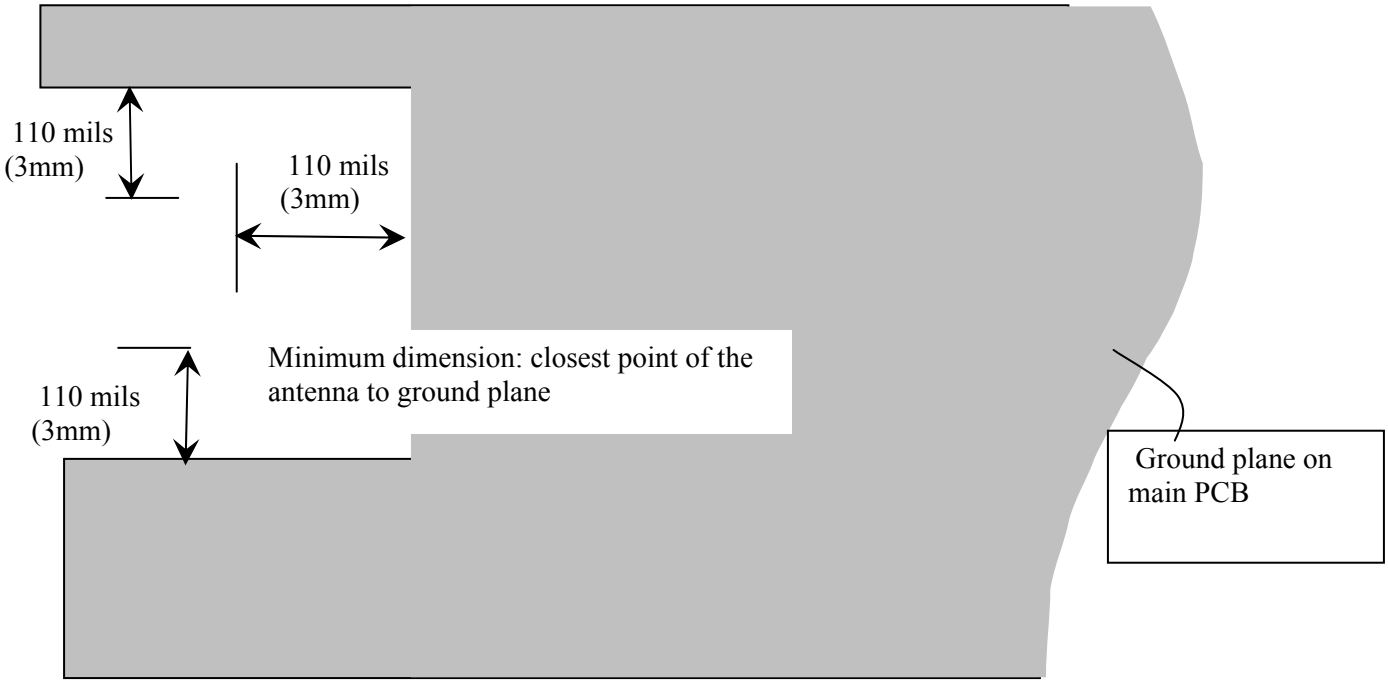
110 mils (3mm)
110 mils (3mm)
110 mils (3mm)
Minimum dimension: closest point of the antenna to ground plane
Ground plane on main PCB

Figure 11-2 Top view of Zigbee module mounting recommendations

ZBA, Inc.
94 Old Camplain Road Hillsborough, NJ 08844
Ph: 908-359-2070 Fax: 908-595-0909
Web: http://www.zbausa.com/

Solder Profile

NOTE: Contact ZBA if you wish **to reflow the Modules in your production environment**. There are specific configurations that need to be reviewed with the production facility to allow for proper reflow of the modules. **SAMPLE QUANTITIES OR SMALL PRODUCTION RUNS WILL TYPICALLY BE CONFIGURED FOR HAND SOLDERING.**

The soldering profile depends on various parameters necessitating a set up for each application. The data here is given only for guidance on solder re-flow. There are four zones:

1. Preheat Zone - This zone raises the temperature at a controlled rate, typically 1-2.5°C/s.
2. Equilibrium Zone - This zone brings the board to a uniform temperature and also activates the flux.
3. The duration in this zone (typically 2 -3 minutes) will need to be adjusted to optimize the out gassing of the flux.
4. Reflow Zone - The peak temperature should be high enough to achieve good wetting but not so high as to cause component discoloration or damage. Excessive soldering time can lead to inter-metallic growth which can result in a brittle joint.
5. Cooling Zone - The cooling rate should be fast, to keep the solder grains small which will give a longer lasting joint. Typical rates will be 2-5°C/s.

Solder Re-Flow Profile

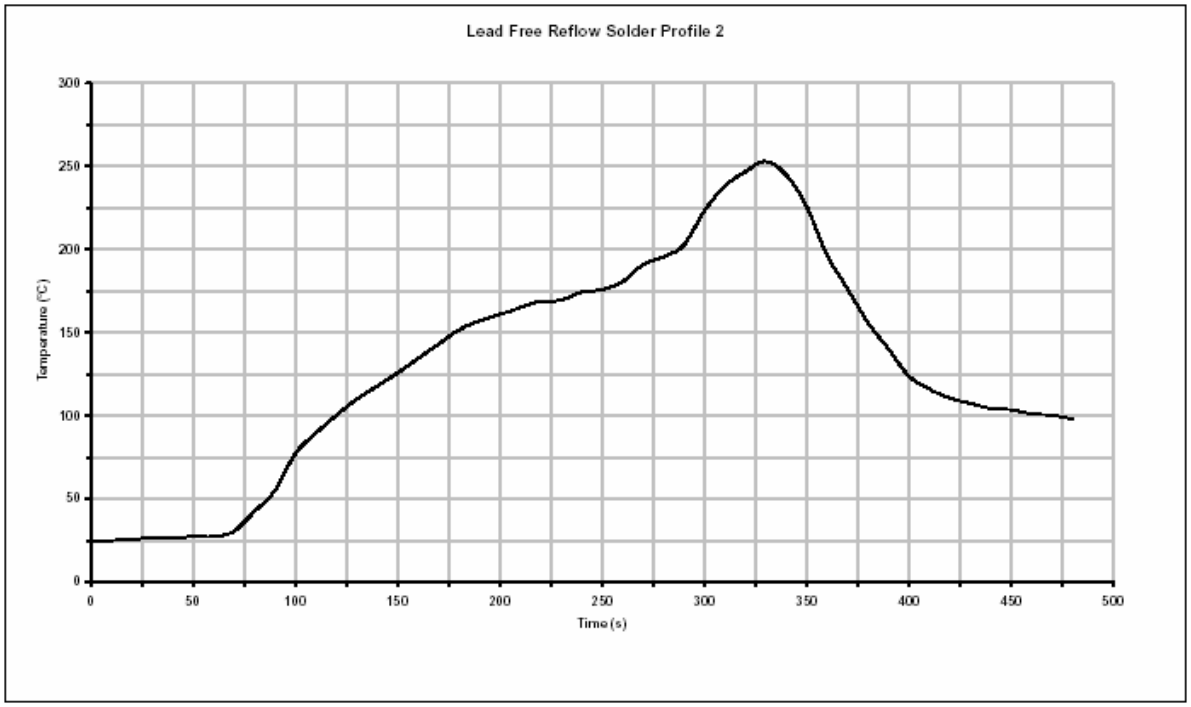

Figure 11-3 Typical Lead-Free Re-flow Solder Profile

12 Ordering Information

ZBA, Inc.
94 Old Camplain Road Hillsborough, NJ 08844
Ph: 908-359-2070 Fax: 908-595-0909
Web: http://www.zbausa.com/

Ordering P/N	Description
ZB88-441S	Class 2 Zigbee Module with On-board ceramic Antenna

Please contact ZBA Inc at 908-359-2070 for any other profiles that you may require.

13 Operational Notes

1. This product is not waterproof, do not install the product directly to outdoor and damp places;
2. This product is a wireless electronic products, please do not install this product in the metal shield of the shell, as installed in the open, where each object is not blocked;
3. This product is installed outdoors, if the surrounding relatively empty, install a lightning rod to prevent lightning strikes.